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Detecting a Sequence of Related Queries to Provide a Combined Set of Structured Answers

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ABSTRACT

When a sequence of queries from a user is formed of queries that are related to each other and generate the same type of direct structured answers, current search engines will serve them independently. As a result, users cannot conveniently view and directly compare answers from the search engine across the multiple queries because these answers are provided within respective answer boxes on the search result page corresponding to each query. This disclosure describes techniques, implemented with user permission, that detect when a user enters a sequence of queries that yield the same type(s) of answers that can be compared with each other. If the user permits, answers to the previous queries in the detected sequence are cached and are shown on the search results page for the current query in the sequence, alongside the direct answer for the current query. Relationships between queries and answers in a sequence can be determined using any suitable technique, e.g., a trained machine learning classifier.

KEYWORDS

- Search engine
- Query sequence
- Query caching
- Related queries
- Direct answer
- Structured answer
- Answer box
- Answer panel

BACKGROUND

Web search engines are routinely utilized to find answers to a variety of questions. For queries that are likely to be associated with a single specific answer, some search engines display the likely answer in the form of a separate user interface (UI) element, such as an answer box. For example, a query such as "How tall is Barack Obama?" can be served by providing the answer "6 feet 1 inches (187 cm)" in an answer box. Typically, the UI elements with the answer(s) to the user's query directly are shown within the search results page in a prominently noticeable location, such as at the top of the list of search results. Alternatively, or in addition, the user can be shown various information sources that are likely to include the answer to the query. For instance, the response to the query "How tall is Barack Obama?" can include a snippet from an encyclopedia entry on Barack Obama along with a link to the full entry.

Oftentimes, users enter multiple related queries in a sequence. For instance, after issuing the query "How tall is Barack Obama?", the user may search for the height of other American presidents. Similarly, users looking to compare features across different products may perform a series of queries seeking the same type of information for each of the products they are considering. For example, a user who wishes to compare cars based on available cargo space may enter successive queries such as "What is the trunk capacity of car X?," "What is the trunk capacity of car Y?," "What is the trunk capacity of car Z?," etc.

Even when a series contains queries that are related to each other and generate the same type of direct structured answers, currently search engines serve the response to each query independently. As a result, users cannot easily view and compare the direct answers across all of the queries because these answers are provided within respective answer boxes on the search result page corresponding to each of the queries. Currently, users must remember or manually jot

down previous results and/or reissue one or more of the previous queries if they forget or lose the answer obtained for a previous query.

DESCRIPTION

This disclosure describes techniques to automatically detect query contexts where a user enters a sequence of queries that yield the same type(s) of answers that can be compared with each other. If the user permits, the answers to the previous queries in the detected sequence can be shown on the search results page for the current query in the sequence, alongside the direct answer for the current query. The user can then use the shown collection of answers for multiple queries for convenient viewing and comparison of the direct answers across all queries in the sequence.

The described operation is achieved by caching each query and the corresponding metadata, with user permission. Whenever the user issues a new query, it is handled independently to generate search results per normal functionality of the search engine. With user permission, a query that results in a structured direct answer is compared with the direct answers received for cached queries. If the comparison indicates that the current query is related to one or more previously issued queries, the direct answers for those queries are added to the direct answer for the current query. The combined set of answers is displayed within the current search engine results page at a suitable place, e.g., at the top of the search results, in an appropriate format, e.g., a table that facilitates comparisons across queries.

As the user continues to issue additional queries, these are processed and handled in the same manner. With each query detected as part of a sequence of related queries, the combined set of direct answers is extended by addition of the results of the latest query.

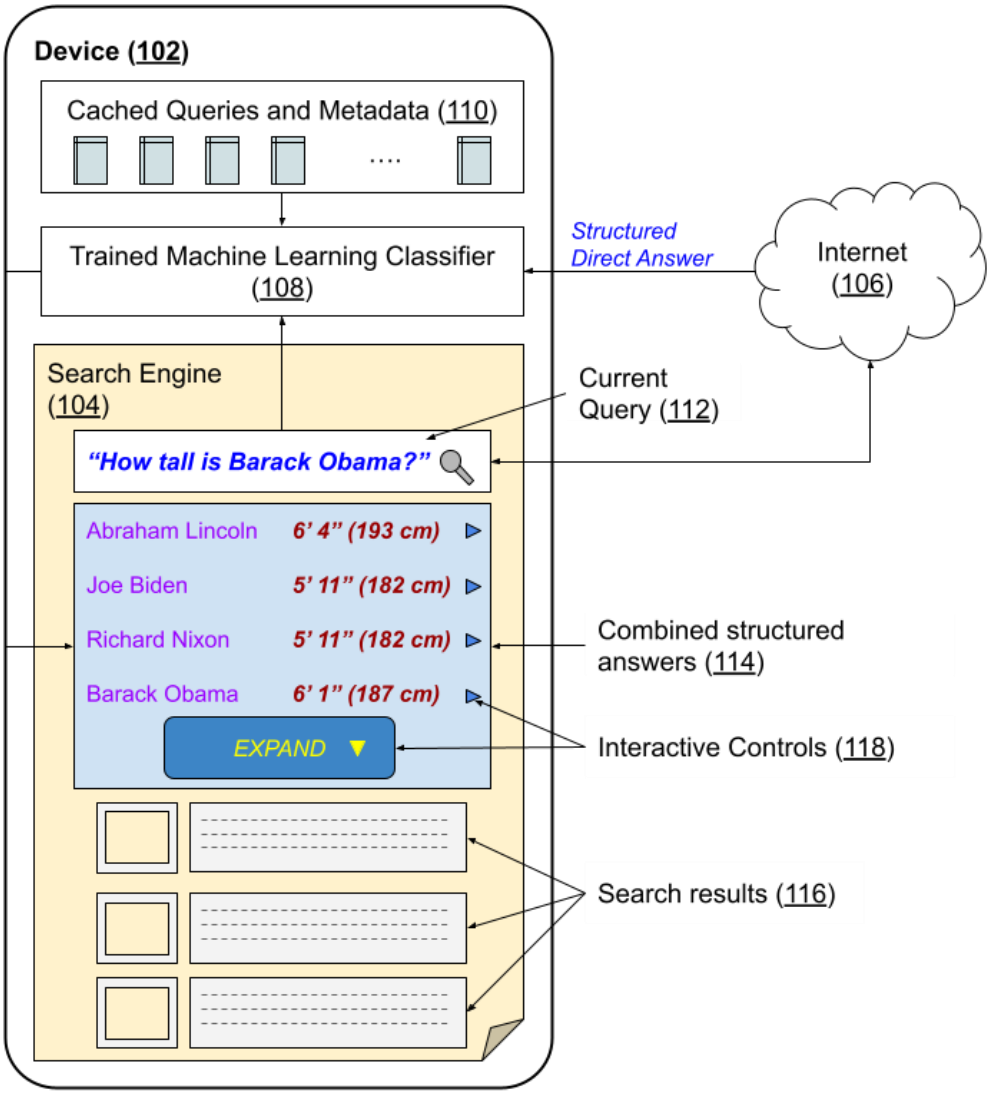

Fig. 1: Providing combined direct answers for a sequence of related queries

Fig. 1 shows an operational implementation of the techniques described in this disclosure. A user issues a query (112) via a search engine (104) accessed using a device (102). With user permission, the query along with its structured direct answer retrieved from the Internet (106) is compared with entries in a cache of previous queries and corresponding metadata (110). For example, such comparison can be performed using a trained machine learning classifier (108).

In the example shown in Fig. 1, since the query is related to several previous queries in the cache, the direct answer for the current query is combined with those for the previous queries

in the detected sequence and displayed in a table of combined answers (114) above the search results (116). The combined table of answers provides various interactive controls (118) that enable the user to perform operations such as expanding the table to include additional queries, reissue a query connected to one of the displayed answers, provide feedback regarding relevance, etc.

The comparison between the current query and past queries can be based on one or more of a number of factors, such as:

- Comparing types of the direct answers after annotating them using standard entity annotation models. For instance, numerical annotations can indicate measurements, currencies, etc.
- Comparing annotated queries to detect whether they contain input entities of the same type, such as persons, products, countries, etc.
- Classifying the queries based on whether they indicate that the user wishes to compare with a previous query (e.g., a query such as “How tall is Barack Obama?” followed by “How about Joe Biden?”).

With user permission, the comparison is used to classify whether a query is related to a previously issued query. The classification can employ heuristics based on factors such as those mentioned above. Alternatively, or in addition, such factors can be input to a suitably trained machine learning model that outputs whether the query is related to a previous one.

With user permission, the set of previous queries used for comparison with the current one can be selected based on one or more of a number of criteria, such as: all queries in the cache, previous N queries, queries issued within a recent time window, etc. The various parameters and threshold values utilized for the operation of the techniques can be set by the

developers and/or specified by the user and/or determined dynamically at runtime. The various components, such as the cache, classifier, etc., can be included within the device, or if the user permits, be provided on a remote server

The combined set of direct answers for all queries in the detected sequence can include answers for the previous M related queries in the sequence. When the number of queries in the sequence exceeds M, older results can be removed from the combined set. Alternatively, the results can be hidden, with an option for the user to expand the currently displayed answers by showing the hidden answers. The combined set of answers can be augmented by including interaction elements for the user to trigger the corresponding query and/or to dismiss irrelevant answers. With user permission, the latter mechanism can be used as feedback for improving the classifier.

As mentioned above, each query within a sequence is handled independently, with comparisons occurring only after the search engine returns results. However, in some cases, such an operation can yield inconsistent results across queries, making it harder to compare the answers. For instance, if the answers for two related queries are obtained from sources located in different countries, they may be affected by local differences in units, formats, conventions, etc.

For example, vehicle characteristics obtained from an European source may use units different from those used by American sources. Moreover, the measurements may be affected by differences in conventions and regulations, such as whether side mirrors are included when reporting the width of the vehicle. To avoid such inconsistencies and enhance the comparability of answers for a sequence of related queries, the user can choose to allow the provision of relevant adjustment information when issuing a query to the search engine. For instance, if query classification performed as above indicates that the current query is likely to be part of a

sequence, the information can be passed on to the search engine in order to request (or force) the direct answer to the query to be obtained from the same or similar sources as those that delivered the answers for the previous queries in the sequence.

With user permission, the techniques can be applied for comparing attributes for query sequences covering a wide range of answer types, such as product attributes, location opening hours, customer ratings, physical measurements, etc. In many cases, the direct answers are descriptive strings that cannot be easily annotated and compared numerically. In such cases, the techniques can include options to list relevant answer strings or snippets for generating and displaying the combined set of answers for the user to parse and compare manually.

With user permission, the techniques described in this disclosure can be implemented by any search engine and provided within any operating system, browser, platform, or application that interacts with the search engine. Implementation of the techniques can help users make seamless comparisons of direct answers across a sequence of related queries without taking explicit actions or needing to reissue past queries, thus enhancing the user experience (UX) of searching for answers via search engines.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's recent and/or past queries or search preferences), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code,

or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

This disclosure describes techniques to detect with permission when a user enters a sequence of queries that yield the same type(s) of answers that can be compared with each other. If the user permits, a query that results in a structured direct answer is compared with the direct answers received for cached previous queries. If the comparison indicates that the current query is related to one or more previously issued queries, the answers to the previous queries in the detected sequence can be shown with permission on the search results page for the current query in the sequence, alongside the direct answer for the current query. The combined set of answers is displayed within the current search engine results page at an appropriate place (e.g., at the top of the search results) in an appropriate format (e.g., a table that facilitates comparisons across queries). Implementation of the techniques enables users to make seamless comparisons of direct answers across a sequence of related queries without taking explicit actions or needing to reissue past queries, thus enhancing the user experience (UX) of searching for answers via search engines.